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(54) ORGANIC EL ELEMENT

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an organic EL(electroluminescence) element which has high electric power converting efficiency and is excellent in uniform light emitting performance and has a long element sevice life.
SOLUTION: In this organic EL element, a positive electrode, an organic substance layer of a single layer structure or a multilayer structure having a light emitting layer containing an organic light emitting material and a negative electrode are laminated in order on a base board. The negative electrode is formed by successively arranging two areas of an alloy area which contains alkaline metal or alkaline earth metal having a work function not more than 2.9eV by 0.5 to 5at.% in the total amount of the alkaline metal and the alkaline earth metal and has a thickness of 5 to 50nm and an upper metallic area composed of metal having a work function not less than 3.0eV in this order when viewed from the organic substance layer side. The oxygen existent concentration in the negative electrode is set not more than 1at%.

CLAIMS

[Claim(s)]
[Claim 1] In the organic EL device with which the laminating of an anode plate, the organic layer of the monolayer structure equipped with the luminous layer containing an organic luminescent material or multilayer structure, and the cathode is carried out one by one on the substrate said cathode alkali metal or the alkaline earth metal of 2.9eV or less of work functions -- the total amount of this alkali metal and this alkaline earth metal -- 0.5 - 5at% -- two fields with the up metal field which consists of a metal of an alloy field with a thickness of 5-50nm and 3.0eV or more of work functions to contain The organic EL device which comes to carry out sequential formation, in view of said organic layer side, and is characterized by oxygen's in this cathode existence concentration being less than [1at%].
[Claim 2] The organic EL device according to claim 1 said whose alkali metal an alloy field consists of an alloy which contains only alkali metal among alkali metal and the alkaline earth metal of 2.9eV or less of work functions, and is a lithium (Li).
[Claim 3] The organic EL device according to claim 1 said whose alkaline earth metal an alloy field consists of an alloy which contains only the alkaline earth metal of 2.9eV or less of work functions among alkali metal and the alkaline earth metal of 2.9eV or less of work functions, and is calcium - (calcium).
[Claim 4] The organic EL device according to claim 1 said whose alkaline earth metal an alloy field consists of an alloy which contains only the alkaline earth metal of 2.9eV or less of work functions among alkali metal and the alkaline earth metal of 2.9eV or less of work functions, and is strontium (Sr).

[Claim 5] An organic EL device given in any 1 term of claim 1 - claim 4 which the metal which forms the up metal field becomes from the mixture of two or more sorts of metals chosen from one sort of simple substance metals chosen from the group which consists of aluminum (aluminum), magnesium (Mg), gold (Au), silver (Ag), copper (Cu), zinc (Zn), lead (Pb), and tin (Sn), or said group.
[Claim 6] An organic EL device given in any 1 term of claim 1 - claim 5 which are formed under the vacuum environment where the partial pressure of oxygen gas is 5% or less of a partial pressure of water gas when an alloy field measures the partial pressure of gas constituents with a quadrupole mass spectrometer.
[Claim 7] An organic EL device given in any 1 term of claim 1 - claim 6 which are formed under the vacuum environment of a reducing atmosphere with the larger partial pressure of hydrogen gas than the partial pressure of water gas when an alloy field measures the partial pressure of gas constituents with a quadrupole mass spectrometer.
[Claim 8] An organic EL device given in any 1 term of claim 1 - claim 7 which are formed by the film production equipment with which the alloy field was equipped with cryopump or a trap device.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to an organic electroluminescence ("electroluminescence" is hereafter written as "EL".) component.
[0002]
[A Prior art and the purpose of invention] The organic EL device is making the structure where the laminating of an anode plate, the organic layer of the monolayer structure equipped with the luminous layer containing an organic luminescent material or multilayer structure, and the cathode was carried out one by one. When the aforementioned organic layer is monolayer structure, the organic layer concerned consists of a luminous layer, and when the aforementioned organic layer is multilayer structure, the organic layer concerned is making lamination, such as a hole-injection layer-luminous layer, a luminous layer-electron injection layer, or a hole-injection layer-luminous layer-electron injection layer, in order from the anode plate side.
[0003] In the organic EL device which is making the above-mentioned structure, when the electron poured into the luminous layer through the direct or electron injection layer from the electron hole and cathode which were poured into the luminous layer through the direct or hole-injection layer from the anode plate recombines, luminescence is produced. As a means for raising the luminescence property of an organic EL device based on such luminescent mechanism, amelioration of an organic luminescent material or an impregnation ingredient (a hole-injection ingredient, electron injection ingredient), selection, amelioration of a cathode material, etc. are known. Among these, selection and amelioration of a cathode material tend to improve the injection efficiency of the electron poured into a luminous layer through a direct or electron injection layer from cathode, and tend to aim at improvement in a luminescence property by this. From from [in improving the injection efficiency of the electron to a luminous layer], it is examined that lowering the impregnation obstruction at the time of pouring in an electron from cathode to the electronic conduction level of an organic layer (a luminous layer or electron injection layer) uses the small metal of a work function as a cathode material desirably therefore.
[0004] Although it is Mg system electrode which is most used as cathode for organic EL devices now using [using the magnesium (Mg) which is one of the alkaline earth metal as an electron injection metal] silver (Ag) etc. as a stabilization metal, it is further examined rather than Mg also about forming cathode using other alkaline earth metal the work function excels [alkaline earth metal] in electron injection nature small, or alkali metal.
[0005] For example, light metals, such as aluminum, calcium, Mg, and Be, are used as a mother metal, and the organic EL device which formed the cathode of monolayer structure with the alloy which made the mother metal concerned contain at least one sort of alkali metal (Li, Na, K, Rb, Cs) one to 99% of the weight is indicated by JP,60-165771,A.
[0006] moreover -- JP,4-212287,A -- metals other than alkali metals (Mg, aluminum, In, Sn, Zn, Zr, Ag, etc.) -- alkali metals (Li, Na, K, etc.) -- more than 6 mol % -- the organic EL device which formed the cathode of monolayer structure with the alloy made to contain -- and The organic EL device in which the cathode of the two-layer structure was formed is indicated by preparing the difficulty corrosive metal layer which consists of Mg, Sn, aluminum, In, nickel, Cu, Ag, Au, Pt, Zn, etc. further on the layer which consists of the aforementioned alloy.
[0007] and to JP,5-121172,A (1) The organic EL device which formed the cathode of monolayer structure for the lithium with the 0.01 - 0.1 weight ****** alloy to the aluminum 100 weight section, (2) The organic EL device which formed the cathode of the two-layer structure by preparing the protection electrode which consists of aluminum or magnesium on the alloy cathode of the above (1), (3) The organic EL device which formed the cathode of monolayer structure for strontium with 10 - 25 weight ****** alloy to the magnesium 100 weight section, (4) The organic EL device which formed the cathode of the two-layer structure by preparing the protection electrode which consists of aluminum or magnesium on the alloy cathode of the above (3), (5) The organic EL device which formed the cathode of monolayer structure with the alloy which contains a lithium below 50 weight sections to the aluminum or magnesium 1000 weight section, (6) The organic EL device which formed the cathode of the two-layer structure by preparing the protection electrode which consists of aluminum or magnesium on the alloy cathode of the above (5), (7) The organic EL device which formed the cathode of monolayer structure with the alloy which contains strontium below the 400 weight sections to the

aluminum or magnesium 1000 weight section, And (8) Organic EL device ** in which the cathode of the two-layer structure was formed is indicated by preparing the protection electrode which consists of aluminum or magnesium on the alloy cathode of the above (7).
[0008] However, only by using alkali metal or alkaline earth metal as a cathode material, power conversion effectiveness is high and it is difficult to excel in the homogeneity luminescence and to obtain the long organic EL device of a component life.
[0009] The purpose of this invention has high power conversion effectiveness, and is to offer the organic EL device which is excellent in the homogeneity luminescence and can obtain the long thing of a component life easily.
[0010]
[Means for Achieving the Goal] The organic EL device of this invention which attains the above-mentioned purpose An anode plate, the organic layer of the monolayer structure equipped with the luminous layer containing an organic luminescent material or multilayer structure, and cathode are the organic EL devices by which the laminating is carried out one by one on the substrate. Said cathode alkali metal or the alkaline earth metal of 2.9eV or less of work functions -- the total amount of this alkali metal and this alkaline earth metal -- 0.5 - 5at% -- two fields with the up metal field which consists of a metal of an alloy field with a thickness of 5-50nm and 3.0eV or more of work functions to contain In view of said organic layer side, it comes to carry out sequential formation and is characterized by oxygen's in this cathode existence concentration being less than [1at%].
[0011]
[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained to a detail. Since the cathode which constitutes the organic EL device concerned consists of two fields of a specific alloy field and an up metal field and the organic EL device of this invention has the greatest description in the point that oxygen's in cathode concerned existence concentration is less than [1at%] as mentioned above, this cathode is explained first.
[0012] In view of the organic layer side which an alloy field with a thickness of 5-50nm and an up metal field mention later, it comes to carry out sequential formation of the cathode which constitutes the organic EL device of this invention in this order. Here, by less than 5nm, since the gestalt as film is imperfect, the thickness of the aforementioned alloy field may not be produced depending on the location, and there is a problem also from the field of the repeatability of film production. On the other hand, although the alkali metal contained to the alloy field concerned or the alkaline earth metal of 2.9eV or less of work functions will be distributed to near the cathode surface and it will be based also on the amount of alkali metal or alkaline earth metal if the thickness of the aforementioned alloy field exceeds 50nm, in such alkali metal or alkaline earth metal, degradation of oxidation etc. becomes easy to advance. Therefore, thickness of the aforementioned alloy field is set to 5-50nm. The gestalt maintenance as film, the repeatability of film production, the oxidation resistance of it being especially 10-30nm, etc. are [the thickness of an alloy field] desirable from a viewpoint of engine-performance (electron injection nature) maintenance.
[0013] the alloy field concerned -- alkali metal or the alkaline earth metal of 2.9eV or less of work functions -- the total amount of the alkali metal and the alkaline earth metal concerned concerned -- 0.5 - 5at% -- it consists of an alloy to contain. here -- this invention -- each element -- attaching -- **** -- obtaining -- the value of a "work function" -- " -- it is based on the data indicated by the 4729th page of J.Appl.Phys. 48th volume" (1977).
[0014] As an example of alkali metal, a lithium (Li; 2.9eV of work functions), sodium (Na; 2.75eV of work functions), a potassium (K; 2.3eV of work functions), a rubidium (Rb; 2.16eV of work functions), and caesium (Cs; 2.14eV of work functions) are mentioned. Moreover, as an example of the alkaline earth metal of 2.9eV or less of work functions, calcium (calcium; 2.87eV of work functions), strontium (Sr; 2.59eV of work functions), and barium (Ba; 2.7eV of work functions) are mentioned.
[0015] the alkali metal of the above [alloy / which forms an alloy field] among alkali metal and the alkaline earth metal of 2.9eV or less of work functions -- one sort -- or two or more sorts are contained -- you may make -- the aforementioned alkaline earth metal -- one sort -- or two or more sorts may be made to contain and one sort of said alkali metal or two or more sorts, one sort of the aforementioned alkaline earth metal, or two or more sorts may be made to contain, respectively
[0016] However, the total amount of the alkali metal and the alkaline earth metal of 2.9eV or less of work functions which the above-mentioned alloy (alloy field) is made to contain in any case is made into 0.5 - 5at% of within the limits. There are too few contents of the low work function metal

(aforementioned alkali metal and the aforementioned aforementioned alkaline earth metal) with which the total amount of the aforementioned alkali metal and the aforementioned alkaline earth metal bears electron injection nature less than [0.5at%], and electron injection nature becomes inadequate, and, as for repeatability ****** of an alloy presentation, the repeatability of the component engine performance falls. On the other hand, if the total amount of the aforementioned alkali metal and the aforementioned alkaline earth metal exceeds 5at(s)%, while there will be too much such alkali metal and alkaline earth metal which are an activity metal and the oxidation resistance of a component will fall, the homogeneity of luminescence -- the point emitting [-less] light increases -- falls. As for the total amount of the aforementioned alkali metal and alkaline earth metal, it is desirable that it is especially 1 - 3at%.

[0017] Moreover, although the content of the total amount of the alkali metal and the alkaline earth metal of 2.9eV or less of work functions in the above-mentioned alloy (alloy field) may be applied to an up metal side from the organic layer side mentioned later and may be substantially uniform, it is desirable to apply to an up metal side from an organic layer side, and to change from high concentration to low concentration gradually. At this time, said content [/ an interface and near / its / the organic layer] may be the high concentration of about 10at%.

[0018] On the other hand as metal components (henceforth "the 2nd metal") other than the alkali metal in the above-mentioned alloy (alloy field), and the alkaline earth metal of 2.9eV or less of work functions The class of alkali metal and alkaline earth metal of 2.9eV or less of work functions is embraced. In various metals, such as aluminum (aluminum), magnesium (Mg), gold (Au), silver (Ag), copper (Cu), zinc (Zn), lead (Pb), and tin (Sn), although two or more sorts can be used, one sort or the thing from which membranous becomes a good alloy is desirable. As a desirable combination of alkali metal and the 2nd metal, the thing of for example, following the (1) - (2) is mentioned, and the thing of following (i) - (iii) is mentioned as a desirable combination of the alkaline earth metal of 2.9eV or less of work functions, and the 2nd metal.

[0019] - alkali metal and the 2nd metal -- desirable -- combining -- (1) When alkali metal is Li, it is desirable to use aluminum, Mg, Ag, Au, Cu, Zn, Pb, or Sn as the 2nd metal, and it is desirable to use aluminum, Zn, Pb, or Sn especially.

(2) When alkali metal is Na, K, Cs, or Rb, it is desirable to use aluminum, Mg, or Ag as the 2nd metal, and it is desirable to use aluminum or Mg especially.

[0020] - alkaline earth metal and the 2nd metal -- desirable -- combining -- (i) When alkaline earth metal is calcium, it is desirable to use aluminum, Mg, Ag, Cu, Zn, Pb, or Sn as the 2nd metal, and it is desirable to use aluminum or Mg especially. O When (ii) alkaline earth metal is Sr, it is desirable to use aluminum, Mg, Au, Ag, Cu, Zn, Pb, or Sn as the 2nd metal, and it is desirable to use aluminum or Mg especially.

(iii) When alkaline earth metal is Ba, it is desirable to use aluminum, Mg, Ag, Cu, Zn, Pb, or Sn as the 2nd metal, and it is desirable to use aluminum, Mg, Sn, or Pb especially. About the formation approach of the above-mentioned alloy field, it mentions later.

[0021] In view of the organic layer side which mentions later the cathode which constitutes the organic EL device of this invention, it comes to carry out sequential formation of the alloy field and up metal field which were mentioned above in this order. And the aforementioned up metal field consists of a metal of 3.0eV or more of work functions.

[0022] Here, as an example of the metal of 3.0eV or more of work functions, aluminum (aluminum; 4.28eV of work functions), magnesium (Mg; 3.66eV of work functions), gold (Au; 5.1eV of work functions), silver (Ag; 4.26eV of work functions), copper (Cu; 4.65eV of work functions), zinc (Zn; 4.33eV of work functions), lead (Pb; 4.25eV of work functions), tin (Sn; 4.42eV of work functions), etc. are mentioned.

[0023] An up metal field may be formed only with one sort of metals whose work functions are 3.0eV or more, and a work function may form it with the mixture (the solid solution and an alloy are included.) of two or more sorts of metals which are 3.0eV or more. Since a good thing is required of membranous [of the whole cathode] in any case, the presentation of the above-mentioned alloy field which is the substrate of the up metal field concerned is taken into consideration, and the presentation is suitably chosen so that a membraneous good up metal field may be formed. As a desirable combination of an alloy field and an up metal field, it is following (a), for example. - (g) A thing is mentioned.

[0024] (a) When the presentation of an alloy field is aluminum-Li, as for an up metal field, it is desirable to consist of aluminum, Mg, Ag, Au, Cu, Zn, Pb, or Sn, and it is desirable to consist of aluminum, Ag, Pb, or Sn especially.

(b) When the presentation of an alloy field is Pb-Li, as for an up metal field, it is desirable to consist of aluminum, Mg, Ag, Au, Cu, Zn, Pb, or Sn, and it is desirable to consist of aluminum, Ag, Pb, or Sn especially.
(c) When the presentation of an alloy field is Sn-Li, as for an up metal field, it is desirable to consist of aluminum, Mg, Ag, Au, Cu, Zn, Pb, or Sn, and it is desirable to consist of aluminum, Ag, Pb, or Sn especially.
(d) When the presentation of an alloy field is Mg-Na, as for an up metal field, it is desirable to consist of aluminum, Mg, Ag, Au, Cu, Zn, Pb, or Sn, and it is desirable to consist of aluminum, Mg, or Ag especially.
[0025] (e) When the presentation of an alloy field is aluminum-calcium, as for an up metal field, it is desirable to consist of aluminum, Mg, Ag, Au, Cu, Zn, Pb, or Sn, and consisting of aluminum or Ag especially is desirable.
(f) When the presentation of an alloy field is aluminum-Sr, as for an up metal field, it is desirable to consist of aluminum, Mg, Ag, Au, Cu, Zn, Pb, or Sn, and consisting of aluminum or Ag especially is desirable.
(g) When the presentation of an alloy field is Mg-Sr, as for an up metal field, it is desirable to consist of aluminum, Mg, Ag, Au, Cu, Zn, Pb, or Sn, and it is desirable to consist of aluminum, Mg, or Ag especially.
[0026] Although especially the thickness of the up metal field mentioned above is not limited, when the thickness is too thin, the capacity to protect the above-mentioned alloy field located in the lower part is missing, and degradation becomes easy to advance by the existence of alkali metal and the alkaline earth metal of 2.9eV or less of work functions contained to the alloy field. On the other hand, if the thickness is too thick, a component will become easy to receive damage with the heat at the time of film production. As for the thickness of these reasons to an up metal field, it is desirable to be referred to in general as 50-300nm according to the presentation, and especially the thing set in general to 100-200nm is desirable. About the formation approach of an up metal field, it mentions later.
[0027] In this invention, oxygen's in cathode which consists of two fields of alloy field [which was mentioned above] and up metal field mentioned above existence concentration is made into less than [1at%] as mentioned above. Here, the oxygen's which measured "oxygen's in cathode existence concentration's is less than [1at%]" in location of arbitration in cathode existence concentration as used in the field of this invention means that it is less than [1at%]. Moreover, it means that the oxygen's which measured "oxygen's in alloy field existence concentration's is less than [1at%]" in location of arbitration in alloy field existence concentration in this specification refers to less than [1at%], and oxygen's which measured "oxygen's in up metal field existence concentration's is less than [1at%]" in location of arbitration in up metal field existence concentration means that it is less than [1at%].
[0028] Since the point concerned emitting [-less] light will be followed and expanded [increase and] to the continuation drive of a component when it becomes easy to produce the point emitting [-less] light in an organic EL device and the point emitting [-less] light arises if oxygen's in cathode, especially alloy field existence concentration exceeds 1at%, the homogeneity luminescence, brightness, and component life of an organic EL device fall, respectively.
[0029] In the organic EL device of this invention, since oxygen's in cathode which consists of two fields of alloy field and up metal field's which were mentioned above existence concentration is as low as less than [1at%], the component which alkali metal and the alkaline earth metal of 2.9eV or less of work functions contain to the aforementioned alloy field in the condition of not receiving oxidation substantially can be obtained easily. If neither alkali metal nor the alkaline earth metal of 2.9eV or less of work functions is receiving oxidation, since the content of the total amount of these metals is a specific amount of 0.5 - 5at%, such an organic EL device has power conversion effectiveness high [the electron injection nature of these metals is high, and], and the point emitting [-less] light is remarkable, and it is few. Therefore, it is the organic EL device which can obtain easily what has it highly [power conversion effectiveness] as for the organic EL device of this invention. [that the point emitting /-less / light is remarkable and it is few] It means excelling in the homogeneity luminescence that the point emitting [-less] light is remarkable and it is few. Furthermore, since the up metal field which consists of a metal of 3.0eV or more of work functions is formed in the outside of the aforementioned alloy field, the alkali metal in an alloy field or the alkaline earth metal of 2.9eV or less of work functions is protected by the up metal field concerned. The organic EL device of this invention equipped with the cathode mentioned above as the result is an organic EL device which can obtain the long thing of a

component life easily.
[0030] The organic EL device of this invention which has an above-mentioned property is suitable as a configuration member, a pixel, etc. of a display panel the surface light source of a pager, the back light for a display of a wrist watch, etc., or for organic electroluminescence displays.
[0031] In addition, "a presentation of an alloy field" as used in the field of this invention means what was analyzed as follows. Namely, carry out sequential formation of an anode plate, an organic layer, and the cathode in this order on a substrate, and an organic EL device is obtained. The spatter of that front face is carried out according to Ar ion gun at a fixed spatter rate towards an organic layer side from the cathode surface of this organic EL device. A surface presentation is analyzed for every fixed depth of a certain according to Auger electron spectroscopy (AES) and secondary ion mass spectrometry (SIMS) in that case (the so-called depth profile is measured by AES and SIMS.). The presentation searched for based on the result is meant.
[0032] At this time, presentation of a content metal and identification of an impurity are performed on at% level at AES. Moreover, although it consists of the configuration element same in SIMS as the alloy field of the presentation made into the purpose, produce beforehand some kinds of alloy ingots from which a presentation ratio differs, and the presentation is analyzed by SIMS about these alloy ingots whose presentations are known. It asks for the signal count ratio of alkali metal and the 2nd metal, and the signal count ratio of the alkaline earth metal of 2.9eV or less of work functions, and the 2nd metal, and the calibration curve of these signal count ratios and an actual presentation ratio is created, respectively. And according to each aforementioned calibration curve, it asks for the depth profile about said alkali metal and said alkaline earth metal from the SIMS depth profile about an organic EL device (calibration-curve method). After checking that use measurement by AES together and any components other than an alloy are not contained by one (matrix effect) with required not containing the element other than the aforementioned alkali metal, alkaline earth metal, and the 2nd metal in the alloy ingot of the above used for creation of a calibration curve in order for SIMS to discuss quantum nature in order to check this condition, it argues about the quantum result by SIMS. The validity of the presentation ratio called for as mentioned above by SIMS was checked with the average concentration in the whole cathode which was made to carry out elution of the whole cathode, and asked for it from ICP analysis (inductively coupled plasma-atomic emisson spectroscopy).
[0033] The above-mentioned cathode which constitutes the organic EL device of this invention is producible what (in this case, the organic layer later mentioned on an alloy field is formed.) an alloy field is formed for on the up metal field concerned after forming an up metal field on the alloy field concerned after forming an alloy field on the organic layer mentioned later, or forming an up metal field. An alloy field and an up metal field can be formed by various approaches, such as vacuum evaporation technique (resistance heating vacuum deposition, electron beam vacuum deposition, a radio frequency heating method, hot wall vacuum deposition, etc.), a molecular beam epitaxy method, the ion plating method, ionized cluster beam vacuum deposition, and the sputtering method, respectively. the case where the up metal field which consists of an alloy field or two components or more is formed with a vacuum deposition method -- the vacuum deposition concerned -- unitary vacuum evaporationo -- you may be -- duality -- you may be the above plural coincidence vacuum evaporationo. The same thing can be said also about the case where the up metal field which consists of an alloy field or two components or more is formed by approaches other than a vacuum deposition method.
[0034] Even when forming cathode by what kind of approach, by the time it forms an up metal field on the alloy field concerned from formation of the alloy field to an organic layer top or from in [preventing that dust mixes to that the aforementioned alloy field will oxidize by the time it forms an organic layer on the alloy field concerned from formation of an alloy field, or a component etc.] It is desirable the same approach and to form an alloy field and an up metal field continuously with the same equipment practical rather than it forms an alloy field and an up metal field by mutually different approach. By the time it forms an up metal field on the alloy field concerned here from formation of the alloy field as used in this specification "which forms an alloy field and an up metal field continuously" Or it means performing formation of an alloy field and an up metal field, or an organic layer one by one, as an alloy field cannot touch air, by the time it forms an organic layer on the alloy field concerned from formation of an alloy field.
[0035] If in charge of forming an alloy field by the approach illustrated in the top, it is desirable to produce a film by carrying out like following (I) or (II) from from [in making oxygen's in alloy field concerned existence concentration into less than 1 at%].

(I) when the total pressure (it says below, "it is a degree of vacuum at the time of vacuum evaporationo".) of the ambient atmosphere at the time of film production produces a film under the vacuum environment which is 5.0x10-7 - 5.0x10-6Torr (i) The partial pressure of the water gas in said ambient atmosphere is set in general to 3.0x10-7 - 3.0x10-6Torr with the measured value of a quadrupole mass spectrometer. And [whether a film is produced by making the partial pressure of the oxygen gas in the ambient atmosphere concerned into 5% or less of the partial pressure of said water gas with the measured value of a quadrupole mass spectrometer, and] Or the partial pressure of the hydrogen gas in the (ii) aforementioned ambient atmosphere is set in general to 4.0x10-7 - 4.0x10-6Torr with the measured value of a quadrupole mass spectrometer, and a film is produced by the partial pressure of hydrogen gas making the ambient atmosphere concerned a reducing atmosphere higher than the partial pressure of water gas with the measured value of a quadrupole mass spectrometer.
(II) A degree of vacuum produces a film under the high vacuum which is 5x10-9 - 2.0x10-7Torr thru/or an ultra-high-vacuum environment at the time of vacuum evaporationo.
[0036] When it is the film production conditions to which the incidence frequency of the alkali metal to a film production substrate or the alkaline earth metal of 2.9eV or less of work functions becomes higher than the incidence frequency of oxygen or water even when it carries out like the above (I) or (II) and an alloy field is produced, it becomes difficult to form the alloy field whose oxygen's existence concentration is less than [1at%].
[0037] for example, in forming an alloy field with the 1 yuan vacuum deposition method which set the degree of vacuum to 5.0x10-7 - 5.0x10-6Torr at the time of vacuum evaporationo The evaporation rate measured by the quartz-resonator type thickness gage (it is below the same.) Although it can form at stability on the organic layer which mentions the alloy field of a desired metal presentation ratio later by considering as 0.005 - 10 nm/s If a degree of vacuum is made into a pressure higher than 5x10-6Torr at the time of vacuum evaporationo and a film is produced with the evaporation rate of 0.5 - 2 nm/s, it will become difficult to form on the organic layer which mentions later the alloy field of a request metal presentation ratio whose oxygen's existence concentration is less than [1at%]. moreover, in forming an alloy field with the pluralism vacuum deposition method which set the degree of vacuum to 5.0x10-7 - 5.0x10-6Torr at the time of vacuum evaporationo Although it becomes possible to form at stability on the organic layer which mentions the alloy field of a desired metal presentation ratio later by making into 0.005 - 0.1 nm/s extent the evaporation rate of the alkali metal which it is going to make the alloy field concerned contain, or the alkaline earth metal of 2.9eV or less of work functions If a degree of vacuum is made into a pressure higher than 1.0x10-5Torr at the time of vacuum evaporationo and a film is produced with the evaporation rate of 0.005 - 0.01 nm/s, it will become difficult to form on the organic layer which mentions later the alloy field of a request metal presentation ratio whose oxygen's existence concentration is less than [1at%].
[0038] Therefore, in forming an alloy field, the incidence frequency of the alkali metal to a substrate or the alkaline earth metal of 2.9eV or less of work functions and the incidence frequency of the oxygen to a substrate or water are also taken into consideration, and film production conditions are chosen suitably. In case an alloy field is formed with a 1 yuan vacuum deposition method or a pluralism vacuum deposition method, in order to maintain the above-mentioned evaporation rate, it is desirable to carry out supervisory control of the evaporation source temperature in the precision of 0.5 degrees C or less.
[0039] On the other hand, when forming an up metal field by the approach illustrated previously, since the up metal field concerned is not made to contain alkali metal and the alkaline earth metal of 2.9eV or less of work functions, oxygen's existence concentration can be made into less than [1at%] more easily than the case where an alloy field is formed.
[0040] When forming cathode with a vacuum deposition method and the loss by adhering in addition to the homogeneity of the thickness of the film (an alloy field and up metal field) obtained and a substrate is taken into consideration, as for the distance between a substrate and an evaporation source, it is desirable to be referred to as 15-50cm.
[0041] In addition, the above-mentioned "evaporation rate" about the alkali metal as used in this specification and alkaline earth metal does not necessarily mean the rate of sedimentation actually produced from the sticking probability of these metals to the organic layer mentioned later not being 1. From examination of this invention persons, it became clear that the aforementioned sticking probability is remarkably small. Therefore, the aforementioned "evaporation rate" as used in this specification means the concentration (vapor pressure) of the evaporation metal near a thickness gage.

[0042] Moreover, since the water gas in the ambient atmosphere at the time of film production can also serve as a source of supply of oxygen in forming an alloy field, it is desirable to stop as low also about the partial pressure of the water gas concerned as possible. For that purpose, it is desirable to use film production equipment equipped with the exhaust air system which has the trap device cooled by film production equipment or liquid nitrogen equipped with the cryopump which is a pump which has effective exhaust velocity to water etc.
[0043] That what is necessary is just to have the above-mentioned cathode which can be formed as mentioned above, the organic EL device of this invention will not be limited, especially if it functions as an organic EL device about the lamination. There are various things as lamination of an organic EL device. As an example of the lamination of the organic EL device of the type which is formed on a transparence substrate and makes the transparence substrate concerned an optical ejection side, the thing of following the (1) - (4) is mentioned for the order of a laminating on the aforementioned transparence substrate, for example. In addition, when not making a substrate into an optical ejection side, the order of a laminating on a substrate can also be made reverse [following the (1) - (4)].
[0044] (1) An anode plate / luminous layer / cathode (2) anode plate / hole-injection layer / luminous layer / cathode (3) anode plate / luminous layer / electron injection layer / cathode (4) anode plate / hole-injection layer / luminous layer / electron injection layer / cathode [0045] Are equivalent to the organic layer of the monolayer structure which a luminous layer calls the organic EL device of the type of the above (1), and the above (1) with a type organic EL device with the reverse order of a laminating at this invention. Are equivalent to the organic layer of the multilayer structure which a hole-injection layer and a luminous layer call the organic EL device of the type of the above (2), and the above (2) with a type organic EL device with the reverse order of a laminating at this invention. Are equivalent to the organic layer of the multilayer structure which a luminous layer and an electron injection layer call the organic EL device of the type of the above (3), and the above (3) with a type organic EL device with the reverse order of a laminating at this invention. With a type organic EL device with the reverse order of a laminating, a hole-injection layer, a luminous layer, and an electron injection layer are equivalent to the organic layer of the multilayer structure as used in the field of this invention with the organic EL device of the type of the above (4), and the above (4).
[0046] Although a luminous layer is usually formed of one sort or two or more sorts of organic luminescent material, it may be formed of mixture with an organic luminescent material, an electron injection ingredient, and/or a hole-injection ingredient, the polymeric materials which distributed the mixture concerned or an organic luminescent material. Moreover, as the organic EL device concerned is covered on the periphery of the organic EL device of lamination mentioned above, the closure layer for preventing invasion of the moisture to an organic EL device or oxygen may be prepared.
[0047] In the organic EL device of this invention, it is not limited especially about the ingredient of layers other than cathode, and various ingredients can be used. Each class other than cathode is explained in full detail below also including a substrate.
[0048] (A) In making a substrate substrate into an optical ejection side, as mentioned above, it uses a transparence substrate. The tabular object which consists of transparence resin, such as the Pori clear glass [, such as alkali glass and non-alkali gas,], polyethylene terephthalate and polycarbonate, polyether sulphone, polyether ether ketone, and vinyl fluoride, polyacrylate, polypropylene, polyethylene, amorphous polyolefine, and fluororesin, or a quartz as that example, a sheet-like object, or a film-like object is mentioned that this transparence substrate should just consist of matter which gives high permeability (in general 80% or more) to luminescence (EL light) from a luminous layer. It is selectable suitably what kind of transparence substrate is used according to the application of the organic EL device made into the purpose etc. On the other hand, when not making a substrate into an optical ejection side, it can use as a substrate also about things other than the transparence substrate mentioned above. The substrate in this case may be an inorganic substance, and may be the organic substance.
[0049] (B) As an ingredient of an anode plate anode plate, the large (for example, 4eV or more) metal, the alloy, the electrical conductivity compounds, or such mixture of a work function are used preferably. As an example, conductive transparent materials, such as metals, such as Au, CuI and ITO, a stannic acid ghost, and a zincic acid ghost, are mentioned. An anode plate is producible by forming the thin film of the above-mentioned ingredient by approaches, such as vacuum deposition and a spatter. When taking out luminescence (EL light) from a luminous layer from an anode plate side, as for the permeability of said EL light in an anode plate, it is desirable that it is 10% or more. Moreover, below hundreds of ohms / ** of the sheet resistance of an anode plate are desirable. Although the thickness of an anode

plate is based also on an ingredient, 10nm - 1 micrometer is usually preferably chosen in 10-200nm.
[0050] (C) An organic luminescent material used as an ingredient of a luminous layer luminous layer (a) An electron hole can be poured in from an anode plate or a hole-injection layer at the time of the impregnation function of a charge, i.e., electric-field impression. The function and (b) which can pour in an electron from cathode or an electron injection layer Transportation function, Namely, the function to which the electron hole and electron which were poured in are moved by the force of electric field, And (c) The place of a luminescence function, i.e., the recombination of an electron and an electron hole, is offered. Be [what is necessary / just although it has three functions of function ** which ties these to luminescence] Above (a) - (c) Having engine performance sufficient about each of each function has a thing suitable as an organic luminescent material also in inside, although the impregnation transportability of an electron hole is more greatly [than electronic impregnation transportability] excellent not necessarily required. As an organic luminescent material, fluorescent brighteners, such as a benzothiazole system, a benzimidazole system, and a benzooxazole system, a styryl benzenoid compound, etc. can be used, for example.
[0051] As an example of the above-mentioned fluorescent brightener, it is 2 and 5-screw (5, 7-G t-pentyl-2-benzoxazolyl) at a benzooxazole system. - 1, 3, 4-thiadiazole, A 4 and 4'-screw (5, 7-t-pentyl-2-benzoxazolyl) stilbene, A 4 and 4'-screw [5 and 7-G (2-methyl-2-butyl)-2-benzoxazolyl] stilbene, 2, 5-screw (5, 7-G t-pentyl-2-benzoxazolyl) thiophene, 2, 5-screw [5-alpha and alpha-dimethylbenzyl-2-benzoxazolyl] thiophene, 2, 5-screw [5 and 7-G (2-methyl-2-butyl)-2-benzoxazolyl]-3, 4-diphenyl thiophene, 2, 5-screw (5-methyl-2-benzoxazolyl) thiophene, A 4 and 4'-screw (2-benzoxazolyl) biphenyl, 5-methyl-2-[2-[4-(5-methyl-2-benzoxazolyl) phenyl] vinyl] benzooxazole, 2-[2-(4-chlorophenyl) vinyl] [1 and 2-naphth d] oxazole etc. is mentioned. At a benzothiazole system, they are 2 and 2'. -(p-phenylenedivinylene)- Bis-benzothiazole etc. is mentioned. By the benzimidazole system, 2-[2-[4-(2-benzoimidazolyl) phenyl] vinyl] benzimidazole, 2-[2-(4-carboxyphenyl) vinyl] benzimidazole, etc. are mentioned. Furthermore, other useful compounds are enumerated by chemistry OBU synthetic soybeans (1971), the 628-637th page, and the 640th page.
[0052] moreover, as an example of the above-mentioned styryl benzenoid compound 1, 4-screw (2-methyl styryl) benzene, 1, 4-screw (3-methyl styryl) benzene, 1, 4-screw (4-methyl styryl) benzene, JISUCHIRIRU benzene, 1, 4-screw (2-ethyl styryl) benzene, 1, 4-screw (3-ethyl styryl) benzene, 1, 4-screw (2-methyl styryl)-2-methylbenzene, 1, and 4-screw (2-methyl styryl)-2-ethylbenzene etc. is mentioned.
[0053] Furthermore, besides the fluorescent brightener mentioned above and a styryl benzenoid compound 12-phtalo peri non, for example, 1, 4-diphenyl-1,3-butadiene, 1, 1, 4, and 4-tetra-phenyl-1,3-butadiene, the North America Free Trade Agreement RUIMIDO derivative, A perylene derivative, an OKISA diazole derivative, an aldazine derivative, a PIRAJIRIN derivative, A cyclopentadiene derivative, a pyrrolo pyrrole derivative, a styryl amine derivative, A coumarin system compound, the international public presentation official report WO 90/13148, Appl.Phys.Lett., vol 58, 18, and P1982 (1991) A high molecular compound which is indicated, an aromatic series JIMECHIRI DIN system compound, the following general formula (I)
[Formula 1]

$$(R-Q)_2-Al-O-L \qquad \cdots (I)$$

（式中、Lはフェニル部分を含んでなる炭素数６～２４の炭化水素を表し、Ｏ－Ｌはフェノラート配位子を表し、Ｑは置換８－キノリノラート配位子を表し、Ｒはアルミニウム原子に置換８－キノリノラート配位子が２個を上回って結合するのを立体的に妨害するように選ばれた８－キノリノラート環置換基を表す。）

It can come out and the compound expressed can be used as an organic luminescent material.
[0054] Here, as an example of the above-mentioned aromatic series JIMECHIRI DIN system compound, these derivatives, such as a 1, 4-phenylene dimethylidyne, 4, and 4'-phenylene dimethylidyne, 2, 5-xylylene dimethylidyne, 2,6-naphthylenedimethylidyne, 1,4-biphenylene dimethylidyne, 1, 4-p-terephenylene dimethylidyne, 4, and 4'-screw (2 and 2-G t-buthylphenyl vinyl) biphenyl, 4, and 4'-screw (2 and 2-diphenyl vinyl) biphenyl, are mentioned. Moreover, as an example of a compound expressed with the above-mentioned general formula (I), they are screw (2-methyl-8-quinolate) (p-phenyl phenolate) aluminum (III) and BI. SU (2-methyl-8-quinolate) (1-naphth RATO) aluminum (III) etc. is mentioned.
[0055] In addition, the compound which made the host organic luminescent material mentioned above,

and doped the strong fluorochrome of from blue until green, for example, a coumarin system, said host, and the same fluorochrome to the host concerned is also suitable as an organic luminescent material. When the aforementioned compound is used as an organic luminescent material, it is efficient and green luminescence (the luminescent color changes with classes of dopant.) can be obtained from blue. As an example of the host who is the ingredient of said compound An organic luminescent material (especially preferably for example, 4 and 4'-screw (2 and 2-diphenyl vinyl) biphenyl) of a JISUCHIRIRU arylene frame is mentioned. As an example of the dopant which is the ingredient of said compound Diphenylamino vinyl arylene (especially preferably for example, N and N-diphenylamino biphenyl benzene) and a 4 and 4'-screw [2-[4-(N and N-G p-tolyl) phenyl] vinyl] biphenyl are mentioned.
[0056] as the approach of forming a luminous layer using an organic luminescent material mentioned above -- vacuum deposition, a spin coat method, the cast method, and LB -- although well-known approaches, such as law, are applicable, it is desirable to apply approaches other than the sputtering method. Moreover, as for especially a luminous layer, it is desirable that it is the molecule deposition film. the thing of the thin film which deposition was carried out to the molecule deposition film from the ingredient compound of a gaseous-phase condition here, and was formed, and the film solidified and formed from the ingredient compound of a solution condition or a liquid phase condition -- it is -- usually -- this molecule deposition film -- LB -- with the thin film (molecule built up film) formed of law, it is classifiable with the difference of condensation structure and higher order structure, and the functional difference resulting from it. Furthermore, after melting a binder and organic luminescent material, such as resin, to a solvent and considering as a solution, a luminous layer can be formed also by thin-film-izing this with a spin coat method etc. Thus, although there is especially no limit about the thickness of the luminous layer formed and it can choose suitably according to a situation, the range of 5nm - 5 micrometers is usually desirable.
[0057] (D) That what is necessary is just what has the impregnation nature of an electron hole, or electronic obstruction nature, the ingredient (henceforth a "hole-injection ingredient") of the hole-injection layer prepared if needed [hole-injection layer] can choose suitably what is conventionally used as a hole-injection ingredient of an electronic photo conductor, it can be used for it, and that [its] whose mobility of an electron hole is more than 10-5cm2 / V-s (field strength 104 - 105 V/cm) is desirable. Either the organic substance or an inorganic substance is OK as a hole-injection ingredient.
[0058] As an example, a triazole derivative, an OKISA diazole derivative, an imidazole derivative, The poly aryl alkane derivative, a pyrazoline derivative, a pyrazolone derivative, A phenylenediamine derivative, an arylamine derivative, an amino permutation chalcone derivative, an oxazole derivative, a styryl anthracene derivative, and full -- me -- non -- a derivative -- A hydrazone derivative, a stilbene derivative, a silazane derivative, polysilane, An aniline system copolymer, conductive polymer oligomer (especially thiophene oligomer), Inorganic semi-conductors, such as a porphyrin compound, an aromatic series tertiary-amine compound, a styryl amine compound, the above-mentioned aromatic series JIMECHIRI DIN system compound shown as an organic luminescent material, and p mold-Si, the p-mold SiC, etc. can be mentioned. As a hole-injection ingredient, it is desirable to use a porphyrin compound, an aromatic series tertiary-amine compound, or a styryl amine compound, and it is desirable to use especially an aromatic series tertiary-amine compound.
[0059] As an example of the above-mentioned porphyrin compound, porphin, 1, 10 and 15, 20-tetrapod phenyl-21H, and 23H-porphin copper (II), 1, 10, 15, 20-tetrapod phenyl-21H, and 23H-porphin zinc (II), 5, 10, 15, 20-tetrakis (pentafluorophenyl)-21H, and 23H-porphin, Silicon phthalocyanine oxide, aluminum phthalocyanine chloride, A phthalocyanine (non-metal), a dilithium phthalocyanine, a copper tetramethyl phthalocyanine, A copper phthalocyanine, a chromium phthalocyanine, a zinc phthalocyanine, a lead phthalocyanine, titanium phthalocyanine oxide, a magnesium phthalocyanine, a copper octamethyl phthalocyanine, etc. are mentioned.
[0060] moreover, as an example of said aromatic series tertiary-amine compound and a styryl amine compound The N, N, N', and N'-tetra-phenyl -4,, 4'-diamino phenyl, N, N'-diphenyl-N, N'-screw-(3-methylphenyl)-[1 and 1'-biphenyl]-4, and 4'-diamine, 2 and 2-screw (4-G p-tolylamino phenyl) propane, 1, and 1-screw (4-G p-tolylamino phenyl) cyclohexane, The N, N, N', and N'-tetra--p-tolyl -4, a 4'-diamino biphenyl, 1 and 1-screw (4-G p-tolylamino phenyl)-4-phenylcyclohexane, A screw (4-dimethylamino-2-methylphenyl) phenylmethane, Screw (4-G p-tolylamino phenyl) phenylmethane, N, N'-diphenyl-N, and N'-JI (4-methoxypheny) -4, a 4'-diamino biphenyl, The N, N, N', and N'-tetra-phenyl -4, 4'-diamino diphenyl ether, 4 and 4'-screw (diphenylamino) KUODORI phenyl, N and N, N-Tori (p-tolyl) amine, 4-(G p-tolylamino)-4'-[4 (G p-tolylamino) Styryl] stilbene, 4-N and N-diphenylamino-(2-

diphenyl vinyl) benzene, 3-methoxy-4'-N and N-diphenylamino stilbene, N-phenyl carbazole, What has two fused aromatic rings in intramolecular like a 4 and 4'-screw [N-(1-naphthyl)-N-phenylamino] biphenyl, a triphenylamine -- a unit -- three -- a ** -- a starburst -- a mold -- connecting -- having had -- four -- four -- ' -- four -- " - tris -- [-- N - (3-methylphenyl) - N - phenylamino --] -- a triphenylamine -- etc. -- mentioning -- having .

[0061] the compound which mentioned the hole-injection layer above -- for example, a vacuum deposition method, a spin coat method, the cast method, and LB -- it can form by thin-film-izing by well-known approaches, such as law. Although especially the thickness as a hole-injection layer is not restricted, it is usually 5nm - 5 micrometers. This hole-injection layer may be 1 layer structure which consists of one sort of the ingredient mentioned above, or two sorts or more, and may be double layer structure which consists of two or more layers of the same presentation or a different-species presentation.

[0062] (E) The ingredient (henceforth an "electron injection ingredient") of the electron injection layer prepared if needed [electron injection layer] should just have the function to transmit the electron poured in from cathode to a luminous layer. Generally, as compared with the electron affinity of an organic luminescent material, a small thing has a greatly desirable electron affinity as compared with the work function (the minimum thing when cathode is multicomponent) of cathode. However, a big electron injection obstruction will exist there and the place where the difference of energy level is extremely large is not desirable. As for the electron affinity of an electron injection ingredient, it is desirable that it is magnitude comparable as the electron affinity of the work function of cathode or an organic luminescent material. Either the organic substance or an inorganic substance is OK as an electron injection ingredient.

[0063] as an example -- nitration full -- me -- non -- a derivative and an anthra quinodimethan derivative -- Heterocycle tetracarboxylic acid anhydrides, such as a diphenyl quinone derivative, a thiopyran dioxide derivative, and naphthalene perylene, A carbodiimide, a deflection ORENIRIDEN methane derivative, an anthrone derivative, An OKISA diazole derivative, a series of electron transport nature compounds currently indicated as an ingredient of a luminous layer in JP,59-194393,A, The thiazole derivative which the oxygen atom of an oxadiazole ring permuted by the sulfur atom, A quinoxaline derivative with the quinoxaline ring known as an electron withdrawing group, the metal complex (for example, tris (eight quinolinol) aluminum --) of an eight-quinolinol derivative Tris (5, 7-dichloro-eight quinolinol) aluminum, tris (5, 7-dibromo-eight quinolinol) aluminum, Tris (2-methyl-eight quinolinol) aluminum, tris (5-methyl-eight quinolinol) aluminum, screw (eight quinolinol) zinc, etc., The metal complex which the central metal of these metal complexes placed and replaced with In, Mg, Cu, calcium, Sn, Ga, or Pb, A JISUCHIRIRU pyrazine derivative, above-mentioned n mold-Si and above-mentioned n mold which were shown as that by which a metal free-lancer, metal phthalocyanines, or these ends are permuted by the alkyl group, the sulfone radical, etc., and an organic luminescent material - Inorganic semi-conductors, such as SiC, etc. are mentioned.

[0064] the compound which mentioned the electron injection layer above -- for example, a vacuum deposition method, a spin coat method, the cast method, and LB -- it can form by thin-film-izing by well-known approaches, such as law. Although especially the thickness as an electron injection layer is not restricted, it is usually 5nm - 5 micrometers. This electron injection layer may be 1 layer structure which consists of one sort of the ingredient mentioned above, or two sorts or more, and may be double layer structure which consists of two or more layers of the same presentation or a different-species presentation.

[0065] As explained above, in the organic EL device of this invention, various matter also including a substrate can be used about each class other than cathode, and the lamination, especially lamination of the organic layer as used in the field of this invention can also be considered as various configurations. Moreover, each class and cathode which constitute an anode plate and an organic layer can be formed by various approaches, as mentioned above, but if a vacuum deposition method is used in formation of each class, since they can form an organic EL device only with this vacuum deposition method, when aiming at simplification of a facility, and compaction of the production time, they are advantageous. From formation of each class (the case where the organic layer concerned is monolayer structure is included.) which constitutes an organic layer at least in that case when the target organic EL device carries out sequential formation of an anode plate, an organic layer, and the cathode in this order on a substrate to formation of cathode When the target organic EL device carries out sequential formation of cathode, an organic layer, and the anode plate in this order on a substrate, perform continuously from formation of

cathode to formation of an anode plate, respectively, namely, it is a certain layer A (the case where it is the alloy field or up metal field which constitutes cathode is included.). It is desirable to carry out, as the aforementioned layer A cannot touch air, by the time it forms after formation the following layer B (the case where it is the alloy field or up metal field which constitutes cathode is included.).

[0066] Moreover, the organic EL device of this invention may have the closure layer for preventing invasion of the moisture to a component, or oxygen like the conventional organic EL device. The copolymer which is made to carry out copolymerization of the monomer mixture containing tetrafluoroethylene and at least one sort of comonomers as an example of the ingredient of a closure layer, and is obtained, The fluorine-containing copolymer which has cyclic structure in a copolymerization principal chain, polyethylene, polypropylene, Polymethylmethacrylate, polyimide, polyurea, polytetrafluoroethylene, Polychlorotrifluoroethylene resin, poly dichlorodifluoroethene, The copolymer of chlorotrifluoroethylene and dichlorodifluoroethene, The absorptivity matter of 1% or more of water absorption, and the dampproof matter of 0.1% or less of water absorption, Metals, such as In, Sn, Pb, Au, Cu, Ag, aluminum, Ti, and nickel, MgO, SiO, SiO2, aluminum 2O3, GeO, NiO, CaO, BaO and Fe 2O3, Y2 O3, the metallic oxide of TiO2 grade, MgF2, LiF, AlF3, and CaF2 etc. -- the thing which made liquefied fluorination carbon and the liquefied fluorination carbon concerned, such as a metal fluoride, a perfluoro alkane, a perfluoro amine, and a perfluoro polyether, distribute the adsorbent which adsorbs moisture and oxygen is mentioned.

[0067] if in charge of formation of a closure layer -- a vacuum deposition method, a spin coat method, the sputtering method, the cast method, and MBE (molecular beam epitaxy) -- law, ionized cluster beam vacuum deposition, the ion plating method, a plasma polymerization method (the high-frequency excitation ion plating method), a reactive-sputtering method, a plasma-CVD method, a laser CVD method, a heat CVD method, a gas source CVD method, etc. are applicable suitably. In using for liquefied fluorination carbon or the liquefied fluorination carbon concerned what distributed the adsorbent which adsorbs moisture and oxygen as an ingredient of a closure layer The organic EL device currently formed on the substrate (there may already be another closure layer.) Outside in collaboration with the aforementioned substrate, an organic EL device is formed for wrap housing material, forming an opening between the organic EL devices concerned. It is desirable to form a closure layer in the space formed of the aforementioned substrate and the aforementioned housing material by filling up aforementioned liquefied fluorination carbon and the aforementioned liquefied fluorination carbon concerned with what distributed the adsorbent which adsorbs moisture and oxygen. What consists of the small glass or the small polymer (for example, 3 fluoride-salt-ized ethylene) of water absorption as the aforementioned housing material is used suitably. The particle which may prepare only the housing material concerned, without preparing the closure layer mentioned above in using housing material, and prepares the layer of the adsorption material which adsorbs oxygen and water in the space formed by the housing material concerned and the aforementioned substrate after preparing housing material, or consists of the adsorption material concerned may be distributed.

[0068]

[Example] Hereafter, the example of this invention is explained.

That (henceforth "a substrate with an anode plate") by which the ITO transparent electrode (equivalent to an anode plate) with a thickness of 100nm is formed on the glass substrate of size of 25x75x1.1mm of production of an example 1 (1) organic EL device was prepared. After cleaning ultrasonically this substrate with an anode plate in an organic solvent, desiccation nitrogen gas was sprayed and the organic solvent was removed from the front face of an ITO transparent electrode. Then, UV ozone washing was performed and the organic substance was removed from the front face of an ITO transparent electrode.

[0069] The vacuum evaporation system (high vacuum vacuum evaporationo equipment made from Japanese Vacuum technology) of marketing equipped with the cryopump which has effective exhaust velocity to water as a main exhaust air pump is used. And a trap device is established so that residual gas, such as water and oxygen, may not adhere to a substrate near the substrate supporter of the vacuum evaporation system concerned. The laminating of a hole-injection layer, a luminous layer, an electron injection layer, and the cathode was carried out one by one in this order on condition that the following on the above-mentioned substrate [finishing / washing] with an anode plate (on the field of the side in which the ITO transparent electrode is prepared), and the organic EL device was obtained. The organic EL device was produced by one vacuum suction, without breaking a vacuum the middle from formation of a hole-injection layer to formation of cathode at this time. Moreover, not all organic materials have degasifying at the time of vacuum evaporationo initiation, and it was made for there to be also no

generating of an impurity in it using a thing [finishing / purification].
[0070] First, using 4, 4', and a 4"-tris [N-(3-methylphenyl)-N-phenylamino] triphenylamine (it being written as "MTDATA" below.) as a hole-injection ingredient for the 1st hole-injection layer, this MTDATA was made to vapor-deposit on condition that 1.0x10 to 6 or less Torrs of degree of vacuums, an evaporation rate 0.1 - 0.3 nm/s at the time of vacuum evaporationo, and the 1st hole-injection layer of 60nm of thickness was formed. At this time, especially the above-mentioned substrate with an anode plate carried out neither heating nor cooling. Next, using a 4 and 4'-screw [N-(1-naphthyl)-N-phenylamino] biphenyl (it being written as "NPD" below.) as a hole-injection ingredient for the 2nd hole-injection layer, this NPD was made to vapor-deposit on the same conditions as the time of said 1st hole-injection stratification, and the 2nd hole-injection layer of 20nm of thickness was formed.
[0071] Subsequently, a 4 and 4'-screw [2-[4-(N and N-G p-tolyl) phenyl] vinyl] biphenyl (it is written as "DTAVBi" below.) and a 4 and 4'-screw (2 and 2-diphenyl vinyl) biphenyl (it is written as "DPVBi" below.) are used as an organic luminescent material. DTAVBi becomes 2.5wt(s)% to DPVBi -- as -- these -- duality -- coincidence vacuum evaporationo was carried out and the luminous layer of 40nm of thickness was formed. A degree of vacuum, substrate temperature, and the evaporation rate of DPVBi were made to be the same as that of the time of formation of the 1st hole-injection layer mentioned above at the time of the vacuum evaporationo at this time.
[0072] Next, it was made to vapor-deposit on the same conditions as the time of formation of the 1st hole-injection layer which mentioned this Alq above, using tris (eight quinolinol) aluminum (it being written as "Alq" below.) as an electron injection ingredient, and the electron injection layer of 20nm of thickness was formed.
[0073] Subsequently, using the Li concentration 10at% alloy base material which consists of aluminum and Li as a vacuum evaporationo ingredient for alloy field formation, the vacuum evaporationo ingredient concerned was made to vapor-deposit on condition that degree of vacuum 1.0x10-6Torr, and an evaporation rate 0.5 - 1.0 nm/s at the time of vacuum evaporationo, and the alloy field with a thickness of 20nm was formed. At this time, supervising the above-mentioned alloy base material by the quartz-resonator type thickness gage so that evaporation of the alloy base material concerned may not take place, in advance of formation of an alloy field, it heated gradually and degasifying was performed. When the ambient atmosphere in the vacuum tub at the time of degasifying was observed with the quadrupole mass spectrometer, growth of the gas of CO2 grade by near [other than growth of hydrogen gas] the evaporation source having been heated by thermal radiation was seen. Formation of an alloy field is CO2. After checking that degasifying, such as gas, has been settled, An evaporation source is further heated until a jump of the alloy from an evaporation source is observed by the quartz-resonator type thickness gage. It carried out, after checking that the evaporation rate was brought close to the above-mentioned rate gradually, the power injection to an evaporation source was controlled so that the evaporation rate concerned was stabilized at the target rate, and the evaporation rate had been stabilized by the quartz-resonator type thickness gage, performing empty and **** where an evaporation source shutter is made close.
[0074] When the ambient atmosphere in the vacuum tub at the time of alloy field formation was observed with the quadrupole mass spectrometer, oxygen gas is about 3% of partial pressure reinforcement (2.0x10-9Torr extent) of water gas, and it was checked that the partial pressure reinforcement of water gas decreases and hydrogen gas serves as the first peak. The shutter for evaporation sources was quickly made close after formation of an alloy field, the energization to an alloy base material was cut, and the substrate (the above-mentioned substrate with an anode plate formed to the alloy field) was isolated from the source of vacuum evaporationo.
[0075] After the temperature of an alloy base material fully fell, after performing degasifying about the aluminum concerned, the vacuum evaporationo ingredient (aluminum) concerned was made to vapor-deposit on condition that degree of vacuum 1.0x10-6Torr and evaporation rate 1.0 nm/s extent at the time of vacuum evaporationo, using aluminum as a vacuum evaporationo ingredient for up metal fields, and the up metal field with a thickness of 200nm was formed.
[0076] By having formed the cathode which consists of these two fields by forming the alloy field and up metal field which were mentioned above, and having formed this cathode An anode plate (ITO transparent electrode), a hole-injection layer (a MTDATA layer and NPD layer), The organic EL device with which the laminating of a luminous layer (layer which consists of DTAVBi and DPVBi), an electron injection layer (Alq layer), and the cathode (up metal field which consists of the alloy field and aluminum which consist of aluminum-Li) is carried out one by one on the aforementioned glass

substrate.was obtained. In this organic EL device, a hole-injection layer, a luminous layer, and an electron injection layer are equivalent to "the organic layer of the multilayer structure equipped with the luminous layer containing an organic luminescent material" as used in the field of this invention.
[0077] (2) When the direct current voltage of 6V was impressed between the anode plate-cathode of the organic EL device obtained by the luminescence test above (1) of an organic EL device, it is 1.23 mA/cm2. A current flows and it is brightness 128 cd/m2. Blue luminescence was obtained. The power conversion effectiveness at this time was 5.45 lm/W. Moreover, as long as it observed with viewing and a luminance meter (CS-100 by Minolta Co., Ltd.), the point emitting [-less] light was not accepted in the luminescence side, but it excelled in the homogeneity of luminescence. It is the above-mentioned organic EL device Initial brightness 300 cd/m2 When the direct-current constant current drive was continuously carried out into desiccation nitrogen-gas-atmosphere mind on conditions, by the time the brightness was halved, the long duration of 2600 hours was required. In the meantime, luminescent chromaticity did not change and generating of the point emitting [-less] light was not accepted, either.
[0078] (3) One more organic EL device was further produced like the component-analysis above (1) of cathode, and that presentation was analyzed as follows about the cathode which constitutes this organic EL device. That is, it turns to an anode plate side from a cathode side, and is Ar+. After carrying out the spatter at the spatter rate of 1.5 nm/s and carrying out 10nm spatter of the cathode surface with ion, measurement by the 1st AES and SIMS was performed, after that, about the up metal field, every 15nm, about the alloy field, the spatter was stopped every 5nm again, and the component analysis was performed by AES and SIMS each time. In SIMS, since ion is irradiated on a sample front face, about 5nm and a sample front face are deleted for whenever [of measurement / every]. The spatter and the component analysis were repeated within the limit of the depth in which a carbonaceous signal is observed by AES.
[0079] In addition, in the 9th SIMS measurement, a 170-175nm field is about measured in depth from the original cathode surface. In the 11th SIMS measurement, a 200-205nm field is about measured in depth from the original cathode surface. The 210-215nm field was about measured in depth from the original cathode surface, and the 220-225nm field was about measured in depth from the original cathode surface by 12th SIMS measurement by the SIMS measurement which is the 13th time.
[0080] Consequently, also in any of an up metal field and an alloy field, in AES, oxygen was not detected but oxygen's in these fields existence concentration was less than [1at%] under limit of detection. Moreover, in the alloy field, in AES, only aluminum was detected and Li concentration was under limit of detection (1at%). The measurement result about Li concentration in the cathode by SIMS is shown in Table 1.
[0081]
[Table 1]

表1

陰極表面からの深さ (おおよその値；nm)	Li 濃度 (at%)
0～175	検出限界以下
200～205	0．23
210～215	0．53
220～225	0．12

[0082] Here, it is thought that data with a depth [in Table 1] of 200-205nm are data of the interface of an up metal field and an alloy field, and it is thought that data with a depth of 220-225nm are data of the interface of an alloy field and an electron injection layer. Therefore, about 0.5 at(s)% Li exists in the alloy field.
[0083] In forming the production alloy field of an example 2 (1) organic EL device, the organic EL device was produced completely like the example 1 (1) except having set the evaporation rate to 1.2-1.3nm, and having set thickness of the alloy field concerned to 50nm. The oxygen gas in the ambient atmosphere in the vacuum tub at the time of the formation concerned seen with the degree of vacuum and the quadrupole mass spectrometer at the time of the vacuum evaporationo at the time of alloy field formation and the partial pressure reinforcement of water gas were the same in the example 1 (1) respectively.
[0084] (2) When the direct current voltage of 6V was impressed between the anode plate-cathode of the

organic EL device obtained by the luminescence test above (1) of an organic EL device, it is 0.84 mA/cm2. A current flows and it is brightness 68 cd/m2. Blue luminescence was obtained. The power conversion effectiveness at this time was 4.21 lm/W. Moreover, as long as it observed with viewing and a luminance meter, the point emitting [-less] light was not accepted in the luminescence side, but it excelled in the homogeneity of luminescence like the organic electroluminescence produced in the example 1 (1). When the continuation drive of the above-mentioned organic EL device was carried out on an example 1 (2) and these conditions, by the time the brightness was halved, the long duration of 2000 hours was required. In the meantime, luminescent chromaticity did not change and generating of the point emitting [-less] light was not accepted, either.
[0085] (3) One more organic EL device was further produced like the component-analysis above (1) of cathode, and that presentation was analyzed like the example 1 (3) about the cathode which constitutes this organic EL device. Consequently, in any of an up metal field and an alloy field, oxygen was not detected by AES. The measurement result about Li concentration in the alloy field by SIMS is shown in Table 2.
[0086]
[Table 2]

表2

測定回数 (回目)	陰極表面からの距離 (おおよその値；nm)	Li 濃度 (at%)
11	200～205	0.08
12	210～215	0.53
13	220～225	1.30
14	230～235	2.30
15	240～245	2.48
16	250～255	0.12

[0087] As shown in Table 2, about 0.5 to 2.5 at% Li exists in the alloy field. For the check, the aluminum-Li alloy layer of 50nm of thickness was formed on the quartz-glass substrate on the formation conditions and these conditions of an alloy field in the above (1), and the presentation was searched for by ICP analysis. Consequently, the concentration of Li is 1.74at(s)% and was mostly in agreement with the above-mentioned result [according to / SIMS].
[0088] After forming to an electron injection layer completely like example of comparison 1 example 1 (1), Mg and Ag were made to vapor-deposit on an electron injection layer by the atomic ratio of Mg:Ag=10:1 on condition that degree of vacuum 7.0x10-7Torr, and the total evaporation rate 1.4 - 1.5 nm/s at the time of vacuum evaporationo, and the cathode of 200nm of thickness was formed. In forming cathode, degasifying and the empty, and **** of a vacuum evaporationo ingredient were performed like the example 1 (1). The organic EL device was obtained by forming to this cathode.
[0089] When the direct current voltage of 6V was impressed between the anode plate-cathode of the above-mentioned organic EL device, it is 0.80 mA/cm2. A current flows and it is brightness 31 cd/m2. Blue luminescence was obtained. The power conversion effectiveness at this time was 2.1 lm/W. Moreover, in (?) and a luminescence side, the point emitting [-less] light was slightly accepted by observation with a luminance meter. It is brightness 120 cd/m2 by this organic EL device. The electrical potential difference required in order to obtain luminescence of extent was 7V, and the power conversion effectiveness in the same brightness region (100 cd/m2 neighborhood) was 1/2 or less compared with each organic EL device of an example 1 and an example 2.
[0090] When the continuation drive of this organic EL device was carried out on an example 1 (2) and these conditions, that brightness was halved in the inside of a comparison-short time of about 1000 hours. Although luminescent chromaticity did not change in the meantime, the increment in the point emitting [-less] light was observed slightly. Moreover, one more organic EL device was further produced like the above, and that presentation was searched for by AES about the cathode which constitutes this organic EL device, consequently, except for Mg and Ag -- near the interface of cathode and an electron injection layer -- setting -- the oxygen of Mg oxide origin -- about 3at% -- it was detected.
[0091] In forming the example 2 of a comparison, and an example of comparison 3 alloy field, the

organic EL device was obtained for every example of a comparison completely like the example 1 (1) except having considered as the thickness which considers as the rate which shows an evaporation rate in Table 3 using the aluminum-Li alloy base material of Li concentration shown in the following table 3 as a vacuum evaporationo ingredient, and shows the thickness of an alloy field in Table 3. In addition, in forming an alloy field, degasifying and the empty, and **** of a vacuum evaporationo ingredient were performed like the example 1 (1).
[0092]
[Table 3]

表3

	合金母材におけるＬｉ濃度 (at%)	蒸着速度 (nm/s)	合金領域の厚さ (nm)
比較例2	１５	０．５～１．５	２０
比較例3	０．１	０．２～１．０	２０

[0093] When the continuation drive of the brightness when impressing the direct current voltage of 6V to each above-mentioned organic EL device, power conversion effectiveness, and these organic EL devices is carried out on an example 1 (2) and these conditions, the time amount (brightness half line) taken to halve brightness is shown in the following table 4. Furthermore, Li concentration in the alloy field for which it asked by SIMS like the example 1 (3) is written together to Table 4.
[0094]
[Table 4]

表4

	輝度 (cd/m^2)	電力変換効率 (lm/W)	輝度半減時間 (時間)	Ｌｉ濃度 (at%)
比較例2	４３	３．７１	８００	１０
比較例3	２４	３．２５	１２００	０．０５

[0095] the concentration [in / as shown in Table 4 / in each organic EL device of the example 2 of a comparison, and the example 3 of a comparison / an alloy field] of Li -- this invention -- the limitation to kick -- it was out of range, and the power conversion effectiveness of these organic EL devices was lower than each organic EL device of an example 1 and an example 2, and was shorter than each organic EL device of an example 1 and an example 2. [of brightness half line] In addition, in cathode, oxygen was not detected by the component analysis by AES about which organic EL device of the example 2 of a comparison, and the example 3 of a comparison. Moreover, about the homogeneity of luminescence, these organic electroluminescence was good.
[0096] An example of comparison 4 main exhaust air system is an oil diffusion pump, and the organic EL device was obtained completely like the example 1 (1) except having made the degree of vacuum to 5x10-6Torr, and having made the evaporation rate into 1.5 - 3.0 nm/s at the time of the vacuum evaporationo at the time of alloy field formation, using the high vacuum vacuum evaporationo equipment which does not have the trap device near the substrate attaching part. In addition, when the ambient atmosphere in the vacuum tub at the time of alloy field formation was observed with the quadrupole mass spectrometer, the partial pressure reinforcement of water gas was higher than the partial pressure reinforcement of hydrogen gas, and the partial pressure reinforcement of the water gas concerned was the first peak. And it was 5 times [at the time of the alloy field formation in an example 1 (1)] the partial pressure reinforcement of this water gas of this.
[0097] the brightness when impressing the direct current voltage of 6V to the above-mentioned organic EL device -- 15.8 cd/m2 it is -- the power conversion effectiveness at this time was 4.59 lm/W. Moreover, when the continuation drive of this organic EL device was carried out on an example 1 (2) and these conditions, that brightness was halved in 1000 hours. Furthermore, it was 4.2at% when asked for Li concentration in an alloy field like the example 1 (3). However, since 1 - 2at% oxygen was detected by AES [an interface and near / its / an alloy field and the electron injection layer], the aforementioned Li concentration in an alloy field excepts the value in an interface and its near concerned. Since a carbonaceous signal was not detected by coincidence, the aforementioned oxygen is not the organic substance origin.

[0098] Although the power conversion effectiveness of this organic EL device is each organic EL device of an example 1 and an example 2, an EQC, or more than it, brightness half line is as short as 1000 hours as mentioned above. Moreover, the point emitting [-less] light already existed in the organic EL device concerned in the early phase. Existence of these points emitting [-less] light is imagined to be a thing resulting from 1-2at% oxygen existing an interface and near [its] an alloy field and the electron injection layer. And the number of the points emitting [-less] light increased by the continuation drive of a component, and each point emitting [-less] light was expanded by the continuation drive of a component.
[0099] The organic EL device was obtained completely like the example 1 (1) except having set the degree of vacuum to 1x10-5Torr, and having set the evaporation rate to having used in the example 4 of example of comparison 5 comparison in 2.0-3.0nm/s at the time of the vacuum evaporationo at the time of alloy field formation, using the same high vacuum vacuum evaporationo equipment. In addition, when the ambient atmosphere in the vacuum tub at the time of alloy field formation was observed with the quadrupole mass spectrometer, the partial pressure reinforcement of oxygen gas was about 10% of the partial pressure reinforcement (7.0x10-7Torr extent) of water gas.
[0100] The brightness when impressing the direct current voltage of 6V to the above-mentioned organic EL device was 20 cd/m2, and the power conversion effectiveness at this time was 4.63 lm/W. Moreover, when the continuation drive of this organic EL device was carried out on an example 1 (2) and these conditions, that brightness was halved in 1000 hours. Furthermore, it was 1.2at% when asked for Li concentration in an alloy field like the example 1 (3). However, since 3at(s)% oxygen was detected by AES [an interface and near / its / an alloy field and the electron injection layer], the aforementioned Li concentration in an alloy field excepts the value in an interface and its near concerned. Since a carbonaceous signal was not detected by coincidence, the aforementioned oxygen is not the organic substance origin.
[0101] Although the power conversion effectiveness of this organic EL device is each organic EL device of an example 1 and an example 2, an EQC, or more than it, brightness half line is as short as 1000 hours as mentioned above. Moreover, the point emitting [-less] light already existed in the organic EL device concerned in the early phase. Existence of these points emitting [-less] light is imagined to be a thing resulting from 3at(s)% oxygen existing an interface and near [its] an alloy field and the electron injection layer. And the number of the points emitting [-less] light increased by the continuation drive of a component, and each point emitting [-less] light was expanded by the continuation drive of a component.
[0102] the duality using aluminum and Li as a vacuum evaporationo ingredient after forming to an electron injection layer completely like the production example 1 (1) of an example 3 (1) organic EL device -- the alloy field with a thickness of 50nm was formed with coincidence vacuum deposition on condition that degree of vacuum 5.0x10-7Torr, evaporation rate 2.0 nm/s of aluminum, and evaporation rate 0.01 nm/s of Li at the time of vacuum evaporationo. In forming the alloy field concerned, degasifying and the empty, and **** of each vacuum evaporationo ingredient were performed like the example 1 (1). Then, the up metal field with a thickness of 200nm it is thin from aluminum completely like an example 1 (1) was formed, and the organic EL device was obtained.
[0103] (2) When the direct current voltage of 6V was impressed between the anode plate-cathode of the organic EL device obtained by the luminescence test above (1) of an organic EL device, it is 1.63 mA/cm2. A current flows and it is brightness 167 cd/m2. Blue luminescence was obtained. The power conversion effectiveness at this time was 5.36 lm/W. Moreover, as long as it observed with viewing and a luminance meter, the point emitting [-less] light was not accepted in the luminescence side, but it excelled in the homogeneity of luminescence like the organic electroluminescence produced in the example 1 (1). When the continuation drive of the above-mentioned organic EL device was carried out on an example 1 (2) and these conditions, by the time the brightness was halved, the long duration of about 2500 hours was required. In the meantime, luminescent chromaticity did not change and generating of the point emitting [-less] light was not accepted, either.
[0104] (3) One more organic EL device was further produced like the component-analysis above (1) of cathode, and that presentation was analyzed like the example 1 (3) about the cathode which constitutes this organic EL device. Consequently, in cathode, oxygen was not detected by AES like the example 1 (3). Moreover, Li concentration in the alloy field measured by SIMS was 0.8at(s)%.
[0105] The organic EL device was obtained completely like the example 1 (1) except having made the degree of vacuum to 1.2x10-6Torr, and having made the evaporation rate into 2.0 nm/s at the time of the

vacuum evaporationo at the time of up metal field formation, using Pb as a vacuum evaporationo ingredient for production up metal field formation of an example 4 (1) organic EL device.
[0106] (2) When the direct current voltage of 6V was impressed between the anode plate-cathode of the organic EL device obtained by the luminescence test above (1) of an organic EL device, it is 1.52 mA/cm2. A current flows and it is brightness 153 cd/m2. Blue luminescence was obtained. The power conversion effectiveness at this time was 5.27 lm/W. Moreover, as long as it observed with viewing and a luminance meter, the point emitting [-less] light was not accepted in the luminescence side, but it excelled in the homogeneity of luminescence like the organic electroluminescence produced in the example 1 (1). When the continuation drive of the above-mentioned organic EL device was carried out on an example 1 (2) and these conditions, by the time the brightness was halved, the long duration of about 2450 hours was required. In the meantime, luminescent chromaticity did not change and generating of the point emitting [-less] light was not accepted, either.
[0107] (3) One more organic EL device was further produced like the component-analysis above (1) of cathode, and that presentation was analyzed like the example 1 (3) about the cathode which constitutes this organic EL device. Consequently, in cathode, oxygen was not detected by AES like the example 1 (3). Moreover, Li concentration in the alloy field measured by SIMS was 0.6at(s)%.
[0108] After forming to an alloy field completely like the production example 1 (1) of an example 5 - an example 7 (1) organic EL device, except having used the ingredient shown in the following table 5 as a vacuum evaporationo ingredient, respectively, the up metal field with a thickness of 200nm was formed on the same conditions as an example 1 (1), and the organic EL device was obtained for every example.
[0109] (2) When a continuation drive is carried out on the brightness, the power conversion effectiveness and the example 1 (2), and these conditions when impressing the direct current voltage of 6V between anode plate-cathode about each of the organic EL device of the luminescence trial above of an organic EL device, the time amount (brightness half line) taken to halve the brightness is shown in the following table 5.
[0110]
[Table 5]

表5

	上部金属領域形成時の蒸着材料	有機EL素子		
		輝度 (cd/m²)	電力変換効率 (lm/W)	輝度半減時間 (時間)
実施例5	Ag	120	5.15	2400
実施例6	Zn	115	5.10	2500
実施例7	Sn	100	4.93	2300

[0111] As shown in Table 5, also in which organic EL device of an example 5, an example 6, and an example 7, the power conversion effectiveness is as high as 5.15 lm/W, 5.10 lm/W, or 4.93 lm/W. Moreover, the brightness half line of these organic EL devices is as long as 2400 hours, 2500 hours, or 2300 hours. Furthermore, as long as these organic EL devices were observed with viewing and a luminance meter, the point emitting [-less] light was not accepted in the luminescence side, but it excelled in the homogeneity of luminescence like the organic electroluminescence produced in the example 1 (1). In addition, in which organic EL device of an example 5, an example 6, and an example 7, between continuation drives, luminescent chromaticity did not change and generating of the point emitting [-less] light was not accepted, either.
[0112] (3) One more organic EL device was further produced for every example like the component-analysis above (1) of cathode, and the presentation was analyzed like the example 1 (3) about the cathode which constitutes these organic EL devices, respectively. Consequently, in cathode, oxygen was not detected by AES about which organic EL device as well as an example 1 (3). Moreover, Li concentration in the alloy field measured by SIMS was 0.5at(s)% in each organic EL device of an example 6 and an example 7 0.6at(s)% in the organic EL device of an example 5, respectively.
[0113] After forming to an electron injection layer completely like the production example 1 (1) of an example 8 - an example 9 (1) organic EL device, the alloy field was formed completely like the example 1 (1) except having made the evaporation rate into 1.2 - 1.3 nm/s, using the alloy base material shown in the following table 6 as a vacuum evaporationo ingredient, respectively. Then, using the ingredient shown in the following table 6 as a vacuum evaporationo ingredient, respectively, except having made

the evaporation rate into 1.5 nm/s, the up metal field was formed completely like the example 1 (1), and the organic EL device was obtained for every example.
[0114]
[Table 6]

表6

	合金領域形成時の合金母材		上部金属領域形成時の蒸着
	組　成	Li 濃 度	
実施例8	Sn−Li	0.5	Sn
実施例9	Pb−Li	1	Pb

[0115] (2) When a continuation drive is carried out on the conditions same about each of the organic EL device of the luminescence trial above of an organic EL device as the brightness when impressing the direct current voltage of 6V between anode plate-cathode, power conversion effectiveness, and an example 1 (2), the time amount (brightness half line) taken to halve the brightness is shown in the following table 7.
[0116]
[Table 7]

表7

	輝　度 (cd/m²)	電力変換効率 (lm/W)	輝度半減時間 (時間)
実施例8	85	4.56	2400
実施例9	56	3.85	2200

[0117] As shown in Table 7, also in which organic EL device of an example 8 and an example 9, the power conversion effectiveness is as high as 4.56 lm/W or 3.85 lm/W. Moreover, the brightness half line of these organic EL devices is as long as 2400 hours or 2200 hours. Furthermore, as long as these organic EL devices were observed with viewing and a luminance meter, the point emitting [-less] light was not accepted in the luminescence side, but it excelled in the homogeneity of luminescence like the organic electroluminescence produced in the example 1 (1). In addition, in which organic EL device of an example 8 and an example 9, between continuation drives, luminescent chromaticity did not change and generating of the point emitting [-less] light was not accepted, either.
[0118] (3) One more organic EL device was further produced for every example like the component-analysis above (1) of cathode, and the presentation was analyzed like the example 1 (3) about the cathode which constitutes these organic EL devices, respectively. Consequently, in cathode, oxygen was not detected by AES about which organic EL device as well as an example 1 (3). Moreover, Li concentration in the alloy field measured by SIMS was 2.5at(s)% in the organic EL device of an example 8, and was 1.3at(s)% in the organic EL device of an example 9.
[0119] After forming to an electron injection layer completely like the production example 1 (1) of an example 10 - an example 11 (1) organic EL device, The alloy base material (concentration of calcium = 5at%) which consists of aluminum and calcium which is one of the alkaline earth metal of 2.9eV or less of work functions in the example 10 The alloy base material (concentration of Sr = 5at%) which consists of aluminum and Sr which is one of the alkaline earth metal of 2.9eV or less of work functions in the example 11 is used as a vacuum evaporationo ingredient, respectively. And the alloy field was formed completely like the example 1 (1) except having made the evaporation rate into 1.2 - 1.3 nm/s. Then, the up metal field was formed completely like the example 1 (1), and the organic EL device was obtained for every example.
[0120] (2) When a continuation drive is carried out on the conditions same about each of the organic EL device of the luminescence trial above of an organic EL device as the brightness when impressing the direct current voltage of 6V between anode plate-cathode, power conversion effectiveness, and an example 1 (2), the time amount (brightness half line) taken to halve the brightness is shown in the following table 8.
[0121]
[Table 8]

表8

	輝　度 (cd/m²)	電力変換効率 (lm/W)	輝度半減時間 (時間)
実施例10	60	4.93	2300
実施例11	87	4.85	2500

[0122] As shown in Table 8, also in which organic EL device of an example 10 and an example 11, the power conversion effectiveness is as high as 4.93 lm/W or 4.85 lm/W. Moreover, the brightness half line of these organic EL devices is as long as 2300 hours or 2500 hours. Furthermore, as long as these organic EL devices were observed with viewing and a luminance meter, the point emitting [-less] light was not accepted in the luminescence side, but it excelled in the homogeneity of luminescence like the organic electroluminescence produced in the example 1 (1). In addition, in which organic EL device of an example 10 and an example 11, between continuation drives, luminescent chromaticity did not change and generating of the point emitting [-less] light was not accepted, either.
[0123] (3) One more organic EL device was further produced for every example like the component-analysis above (1) of cathode, and the presentation was analyzed like the example 1 (3) about the cathode which constitutes these organic EL devices, respectively. Consequently, in cathode, oxygen was not detected by AES about which organic EL device as well as an example 1 (3). Moreover, calcium concentration in the alloy field measured by SIMS about the organic EL device of an example 10 was 1.5at(s)%, and Sr concentration in the alloy field measured by SIMS about the organic EL device of an example 11 was 3.2at(s)%.
[0124]
[Effect of the Invention] As explained above, according to this invention, power conversion effectiveness is high, and it becomes possible to excel in the homogeneity luminescence and to offer the long organic EL device of a component life easily.

[Translation done.]